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Patent Ofl
Canberra

I, JULIE BILLINGSLEY, TEAM LEADER EXAMINATION SUPPORT AND SALES hereby certify that annexed is a true copy of the Provisional specification in connection with Application No. 2003900703 for a patent by R.MCDONALD CO. PTY LTD as filed on 18 February 2003.

WITNESS my hand this
Second day of March 2004

J. Billingsley

JULIE BILLINGSLEY
TEAM LEADER EXAMINATION
SUPPORT AND SALES

Regulation 3.2

R. McDonald Co. Pty Ltd

AUSTRALIA

Patents Act 1990

PROVISIONAL SPECIFICATION

for the invention entitled:

"A cooking surface"

The invention is described in the following statement:

A COOKING SURFACE

This invention relates to cooking surfaces on which meat or other pieces of food can be cooked. Although the invention will primarily be described in relation to its application to an outdoor barbeque it can equally be used in domestic and commercial kitchens or anywhere a surface for cooking of food is required.

Traditional cooking surfaces take the form of a hot plate or spaced grill bars of various types. Both hot plates (griddles) and conventional grill bar arrangements primarily cook food by either radiant or conducted heat or a combination of both. In the case of grill bars some form of heat distribution is usually employed between the heat source, usually a gas flame and the grill bars. These may take the form of rocks, metal plates, angled bars and the like, all designed to radiate the heat more evenly at the cooking surface. The heat transmitted to traditional grill bar surfaces is thus a combination of some air heated by the burners that circulates upwardly through the grill bars and radiant heat transmitted from the rocks, metal plates, angled bars and the like. In most cases the radiant heat and some conducted heat from the grill bars themselves perform the majority of the cooking of food on the grill bar surface.

There are a number of disadvantages associated with conventional grill bar cooking surfaces. Firstly, the conducted and radiant heat dominated cooking process tends to dry the foods being cooked. Additionally, it is very difficult to regulate the temperature of the cooking surface of conventional grill bars because of the radiant heat transfer mechanism below. Consequently the grill bars are frequently heated to a point where they will burn or char meat rather than browning it, producing an acrid or burnt taste to the food. Another difficulty is that any fat heated during the cooking process melts and drips through the grill bars and on to the radiating heat source below. These surfaces are heated to an even higher temperature than the grill bars and consequently flare-ups and fat fires frequently result.

It is an object of this invention to provide a cooking surface which will overcome, or at least ameliorate one or more of the foregoing difficulties.

According to one aspect of this invention there is provided a cooking surface defined by a series of parallel closely spaced bars concave on the underside and a corresponding series of burners extending respectively along the bars adjacent the concavity so that melted fats or other material falling from or between the bars fall past the heat source and food on the surface is shielded from the radiant heat of the burner.

Preferably, the gaps between the ratio of the area of the bars forming the cooking surface to the spaces between the bars is about 2.5:1.

The burners are preferably positioned and configured so that the gas flame has the outer mantle just reaching the underside of the corresponding bar. In this way the heat source is as close as possible to the grill bar without the position of the grill bar resulting in incomplete combustion of gas because of restricted flow of the secondary combustion air. The burners are preferably supplied with gas from a manifold extending adjacent one edge of the cooking surface. Preferably an even heat distribution along the burner length is achieved by increasing the size of the gas ports slightly in the direction away from the supply manifold. This has been found to be an effective way to compensate for gas flow friction in the burner which would otherwise reduce heat output towards the remote end of the burner.

The burners are preferably formed with an oval shaped cross section and the elongated dimension of the oval is arranged vertically. This configuration has reduced gas friction compared to a circular burner and also allows a greater cross section area for a given width so that the burner can be shielded by a relatively narrower grill bar.

The grill bars are also preferably sloped upwardly away from the manifold by a small amount so as to provide a flue for the gas burner and ensure complete combustion. Preferably the burners have a slope of about 1%.

The configuration of the grill bars and burners of this invention allows very precise control of the temperature of the grill bars.. Preferably the temperature of the grill bars is controlled to between 280° and 295°C. This enables one to cook at the highest temperature possible to achieve optimum cooking results while reducing the risk of flare-ups and fat fires. This temperature is the point just prior to the flash-point of fat (around 300°C) when it mingles with meat juices.

In one form of the invention a temperature sensor can be provided to provide an input to a feedback gas control to maintain the grill bar temperature at a selected level.

The grill bars are preferably convex on the upper surface. The grill bars can be curved or formed by a central flat section with downwardly angled flanges along the longitudinal sides. In the preferred form of the invention the grill bars are stamped from thin gauge metal. The thin gauge metal has the advantage of heating and cooling relatively quickly.

The gas burners are preferably arranged in a series of discrete banks including a selected number of burners. Each of the banks has its own subsidiary manifold with its own gas cock. Each gas cock is supplied from a primary manifold which is in turn under the control of a single regulator valve. This allows the temperature of regions of the cooking surface to be readily controlled.

It will be apparent the cooking surface of the present invention results in the majority of the cooking at the surface being done by convection rather than radiant and conducted heat. The increase in convective heat ensures that the food retains its juice and enhances its flavour. The convection heat does not seal the outside of the meat as much as radiant and conducted heat and the heat permeates the food more evenly maintaining higher moisture level. Additionally, because each grill bar provides a shield to the burner any fat that melts during the cooking process drips downwardly between the burners. That is, the fat does not come in contact with the burner or any heat source heated to above the flash point of the fat. This virtually eliminates all fat fires during the cooking process. A large

amount of the convection heat is provided by a hot air flow from the region around the burner moving upwardly through the gap between the grill bars. The amount of air that passes through the grill bars and hence the temperature of that air is largely determined by the amount of air admitted to a region below the burners. By providing a suitable housing extending from adjacent the edges of the cooking surface and downwardly underneath the burners, airflow can be regulated through desired apertures provided to optimise the convectional airflow.

The invention also provides a facility for the roasting of foods. Because the cooking surface of this invention provides an effective way in which a convectional airflow of air can be generated it provides an excellent means of heating an oven like space. By placing a suitable hood over the cooking surface, the interior is effectively and evenly heated to roasting temperatures. It will be appreciated that a vent is suitably positioned in the hood or enclosure so as to provide a continual flow of air. The operation of the cooking surface as part of an oven is found to be significantly enhanced by the use of an angled baffle which is positioned over the central burners below the cooking surface. The baffle extends outwardly and upwardly from the central region the food to be roasted is supported on the adjacent portion of the grill bars. The burners in the zone immediately under the baffle are not utilised and the heating takes place indirectly by a convectional flow of air from the banks of burners at the remote edges of the cooking surface. The baffle is also configured so as to drain any fat produced in the roasting process to the center of the baffle which can be provided with an aperture to direct the flow through one of the gaps between the burners.

Preferably the grill bars used in the barbeque are mounted so as to allow for thermal expansion without warping. In one preferred form of the invention the grill bars are mounted by lower edges engaging tracks formed in transversely extending mounting rails. This form of the invention also allows the ready replacement of one or more grill bars. This is particularly useful where the grill bars are treated with a non-stick coating that ultimately may wear or be damaged through misuse.

One embodiment of the invention will now be described, by way of example only, with reference to the accompanying drawings in which:

FIG. 1 is a schematic perspective view of a cooking surface according to the present invention fitted to a barbeque;

FIG. 2 is a schematic section through the barbeque of FIG. 1;

FIG. 3 is a schematic drawing showing detail of the cooking surface according to this invention;

FIG. 4 is a side view of a gas burner forming part of the cooking surface of the present invention;

FIG. 5 is a plan view of the burner shown in FIG. 4;

FIG. 6 is a perspective view of a manifold and cross over tube forming part of the barbeque shown in FIG. 1;

FIG. 7 is a schematic section of the barbeque of FIG. 1;

FIG. 8 is a plan view of part of the barbeque of FIG. 1 showing the connection of the grill bars;

FIG. 9 is another schematic section along the barbeque of FIG. 1;

FIG. 10 is a perspective view of a baffle used in the barbeque of FIG. 1;

FIG. 11 is an end view of a baffle shown in FIG. 10;

FIG. 12 is a further schematic section view of the barbeque of FIG. 1 showing the baffle of FIGS. 10 and 11 positioned in the barbeque; and

FIGS. 13-20 are a series of thermographs of the cooking surface of this invention under various operating conditions.

FIG. 21 is a schematic end view showing one embodiment of the mounting of the

grill bars forming the cooking surface of this invention; and

FIG. 22 is a schematic part plan view of the arrangement shown in Fig. 21.

FIGS. 1 and 2 show the cooking surface 10 of this invention incorporated into an outdoor barbeque 12. The barbeque 12 is of essentially conventional construction other than in relation to the modifications associated with the incorporation of the cooking surface 10. Barbeque 12 has a frame 14 supporting a housing 16. The housing 16 defines a rectangular volume over which the cooking surface 10 of the invention extends. In the schematic drawing of FIG. 1 the near end of housing 16 is not shown so as to allow a drip tray 18 and associated deflector 20 to be seen in position. Drip tray 18 and deflector 20 are of standard type and provided to catch the fat that drips from cooking surface 10. Cooking surface 10 is formed by a series of closely spaced parallel grill bars 22. The grill bars generally arcuate profile with a concave underside 24. Each grill bar 22 has a corresponding elongate gas burner 26 extending along the length of the grill bar 22. The cooking surface is thus not continuous but has a series of gaps 28 between the grill bars 22. The ratio of the area occupied by the grill bars to the area of the gaps in cooking surface is about 2.5:1.

Gas is supplied to the burners 26 via a manifold assembly 30. Manifold 30 is connected to a gas supply line 32 that provides liquefied petroleum gas (LPG) from a conventional cylinder and regulator arrangement (not shown). The LPG is regulated to a pressure of approximately 2.75 kpa by a standard regulator arrangement. It will be apparent that other gas types, such as natural gas, may be used with the corresponding modifications to the burners 26. A cross over tube 34 extends across the burners 26 to provide for ease of lighting. The cross over tube 34 is supplied with gas from gas supply 32 via a line 36.

FIGS. 2 and 3 show the arrangement of the burners 26 and grill bars 22 in further detail. The burners 26 and grill bars 22 are configured so as to protect the burners from any material falling through the gaps 28 between the grill bars 22. Additionally, the concave under surface of the grill bars and the close positioning

of the burners 26 protects food on the cooking surface from the radiant heat of the burner. The heat supplied to the cooking surface 10 is thus a combination of conducted heat from the grill bars 22 and a convective flow of hot air heated by the burners 26 that flows upwardly through the gaps 28 as indicated by arrows 38

The distance between the burners 26 and grill bars 22 is an important parameter. In the preferred form of the invention the distance is adjusted to provide an optimum balance between heating of the grill bars and production of the convection flow of hot air whilst still protecting the food on the cooking surface from direct radiant heat and at the same time protecting the burner from any material falling through gap 28. In practice it has been found that in the preferred form of the invention the burner should be placed as near as possible to the grill bar whilst still allowing substantially complete combustion of the gas from burner 26. This distance varies according to the burner design and precise shape of the grill bar but substantially corresponds to positioning of the burner so that the top of the outer mantle 40 of the gas flame just reaches the grill bar 22.

It will be apparent to those skilled in the art that the positioning of the burner 26 in this way will ensure an adequate supply of secondary air from the region around the flame to ensure complete or substantially complete combustion.

The grill bars 22 can be formed from any suitable material. In a preferred form of the invention they are formed from a pressed thin gauge mild steel. The mild steel grill bars are economical to produce and because they are thin gauge they heat and cool relatively quickly in response to the amount of heat supplied by the burner 26.

FIGS. 4 and 5 show further detail of the construction of the burners 26. The burners 26 have two major components. A mixer portion 44 of substantially conventional type admits primary air through aperture 46 in the substantially conventional manner. The body 48 of the burner is the portion that extends closely adjacent the grill bar 22 as best seen in FIG. 2. The body 48 is of oval section with the major dimension of the oval being oriented vertically. Burner

holes 50 and flame retention holes 51 are formed in the upper surface of the body 48. As shown in the insets to FIG. 4 the burner holes 50 and flame retention holes 51 are alternated. The use of the flame retention holes is conventional practice as will be appreciated by those skilled in the art. The burner holes 50 are arranged in three separate zones. In a first zone 52 extending along approximately the first one third of the body the holes are of 1.0mm diameter. In a second zone 53 the hole diameter increases to 1.1mm and in the final one third of the body 54 the hole sizes increase to 1.2mm. This increase in the size of the burner holes over the length of the burner is provided to compensate for friction encountered by the gas supply as it travels along the length of the body 48. This friction causes an effective drop in the supply of pressure and without the compensation provided by increasing the size of the burner holes 50 a lesser heat output would be obtained at the remote end. Burners 26 are arranged with a slight slope over the length of the burner. In the preferred form of the invention the burners slope upwardly by approximately 5mm over a length of approximately 450mm. That is, there is an upward slope of about 1%. This slope provides a flue effect for the operation of the burner.

FIG. 6 shows an enlarged view of the manifold assembly 30 shown as part of FIG. 1. The manifold assembly has a primary manifold 56 connected to the gas supply 32 via a control valve 58. Gas at the regulated pressure is thus supplied to the primary manifold 56. Four on/off valves 60 are connected to primary manifold 56 to respectively supply gas to burner supply subsidiary manifolds 62,64,66,68. The sub manifolds 62,64,66,68 are not interconnected and each supply gas to five connected gas burners 26. The burners 26 are connected to the subsidiary manifolds 62,64,66,68 in the conventional manner. A pressure gauge 70 is connected to provide an indication of the supply pressure to the burners connected with the subsidiary manifolds. It will be apparent that the division of the burners into four zones effectively corresponding to each of the subsidiary manifolds 62,64,66,68 allows different areas of the barbeque to be controlled separately.

Each of FIGS. 1, 6, 7 and 8 shows the cross over tube used to ensure that any group of burners can be lit once an initial set of burners is alight. Cross over tubes of this type are used in existing barbeques however the cross over 34 of the present invention has a supply of gas separate to any of the sub manifolds so as to prevent any associated pressure drop in the gas supply to the burners.

As is shown from the schematic cross sections of FIGS. 1 and 2 the barbeque 12 of this invention has a housing 16 which completely encloses the region below the cooking surface 10. The admission of air to the interior of housing 16 is controlled by the amount of air gap provided around the fitting of drip tray 18. By ensuring the correct airflow the amount and temperature of the convective air shown by arrows 38 flowing through gaps 28 can be controlled as shown in FIG. 3. In some applications it may be preferable to provide separate apertures or even controlled apertures for this purpose.

FIGS. 10, 11 and 12 relate to the use of the barbeque for heating an oven like space above the grill bars of the barbeque. A hood 72 (shown in FIG. 1) can be fitted to the barbeque in the conventional manner. The hood is preferably hingedly attached in the customary manner and a vent 74 is provided along the rear of the hood. The arrangement of the present invention has been found to be particularly effective in providing hot air for this indirect oven type cooking. In the preferred form of the invention a W-shaped baffle 76 shown in FIGS. 10 and 11 is used to assist in the process. The baffle is fitted over the center most ten burners 26 and sits below the grill bars 22. As shown in FIG. 12 the burners immediately below the baffle 76 are not utilised when the baffle is in place. Food to be roasted for example a chicken is placed on the grill bars 22 immediately above baffle 76. Heating of the area enclosed by hood 72 occurs through the convective flow of air through gaps 28 between the outermost grill bars 22 under which burners 26 are alight. This has been found to provide an effective flow of hot convective air. The central region of baffle 76 is shaped to include two inverted V sections 78 which neatly fit along the central burners 26. This forms three longitudinal channels 80 in which apertures 82 are formed to allow the passage of accumulated juice or fat.

The outwardly extending arms 84 of baffle 76 direct the juices falling through the corresponding gaps 28 towards the corresponding apertures 82.

The barbeque 12 of the preferred embodiment is preferably operated so that the grill bars 22 are heated to between 280° and 295°C. This has been found to produce very good cooking results with a variety of meats. In particular chops and steaks have been found to be particularly evenly cooked and have a high level of moisture retention. During the cooking process flare-ups and fat fires are almost entirely eliminated. As a consequence the cooking process becomes extremely simple. Unlike other forms of open grill the absence of any fat flare ups means that the meat can simply be placed on the grill for a desired time period, and only need to be turned once during the cooking period. This means that the level of skill required to effectively cook on an open grill is limited to a simple timing operation. This advantage of the invention leads to considerable opportunities for use in commercial kitchens with a cost saving on expensive skilled chef time.

Another significant advantage of the present invention is the radiant heat produced at the cooking surface is almost entirely eliminated. This means that the area above the cooking surface is not subject to radiant heat and thus less discomfort is produced when reaching across the cooking surface for example to turn food at the rear of the cooking surface.

FIGS. 13-20 are a series of thermographs showing the heat distribution according to colour and selected spot temperature measurements over the surface of the cooking surface 10 under a number of different conditions. In these measurements the cooking surface was painted black to eliminate variations in emissivity that would affect the temperature measurements.

The conditions for each of the thermograph measurements were as follows:

FIG. 13 - 5 minutes after lighting with a pressure of 1.7 kpa and the cross over alight. The effect of the cross over bar can be seen along the bottom of the thermograph;

FIG. 14 - 10 minutes after initial lighting at a pressure of 2.4 kpa with the cross over alight;

FIG. 15 - 15 minutes after initial lighting at a gas supply pressure of 2.9 kpa with the cross over alight;

FIG. 16 – after 5 minutes with only the outer groups of 5 burners alight and a gas pressure of 1.7 kpa. The cross over is alight in this thermograph. This form of heating is used for the indirect oven like cooking described above;

FIG. 17 – 10 minutes after lighting with a 1.2 kpa pressure and the cross over disabled;

FIG. 18 – 15 minutes after lighting at a pressure of 2.4 kpa with the cross over disabled;

FIG. 19 – 20 minutes after lighting with a gas pressure of 2.9 kpa with the cross over disabled; and

FIG. 20 – 25 minutes after lighting at a pressure of 1.7 kpa without the cross over and with only the outer two groups of five burners alight.

It will be apparent from the thermographs that under a wide variety of operating conditions a very high degree of uniformity or evenness is achieved over the cooking surface of the present invention. From FIGS. 16 and 20 it can be seen that in indirect heating applications the central region of the cooking surface does not provide significant direct heating thus providing a region in which foods can be effectively roasted by the hot convective air supplied from the outer regions of the cooking surface.

FIGS. 21 and 22 relate to the mounting of the grill bars 22 forming the cooking surface 10. In some applications it has been found that thermal expansion of the grill bars 22 during operation can change the distance between the burners 26 and grill bars 22 due to warping if the grill bars are formed in a rigid frame. FIGS. 21 and 22 show a manner of mounting the grill bars so that this difficulty is avoided.

The grill bars 22 are supported at each end by transverse rails 86 which are secured to the housing 16 either permanently by welding or by fastenings (not shown). The rails 86 have a series of small tracks 88 machined across their width to receive the lower corners 90 of the grill bars 22. That is, each grill bar sits in two adjacent tracks 88. The tracks 88 retain the grill bars in spaced position whilst allowing them to freely expand in the longitudinal direction. Additionally, this method of mounting the grill bars 22 allows for grill bars to be readily replaced by simply substituting a new grill bar. This feature can have particular advantage where it is desired to use grill bars with a non-stick coating which might be damaged or ultimately become worn and unserviceable.

The foregoing describes only some embodiments of the present invention and modifications can be made without departing from the scope of the invention.

DATED this 18th day of February, 2003.

R. McDonald Co. Pty Ltd

by DAVIES COLLISON CAVE

Patent Attorneys for the Applicant

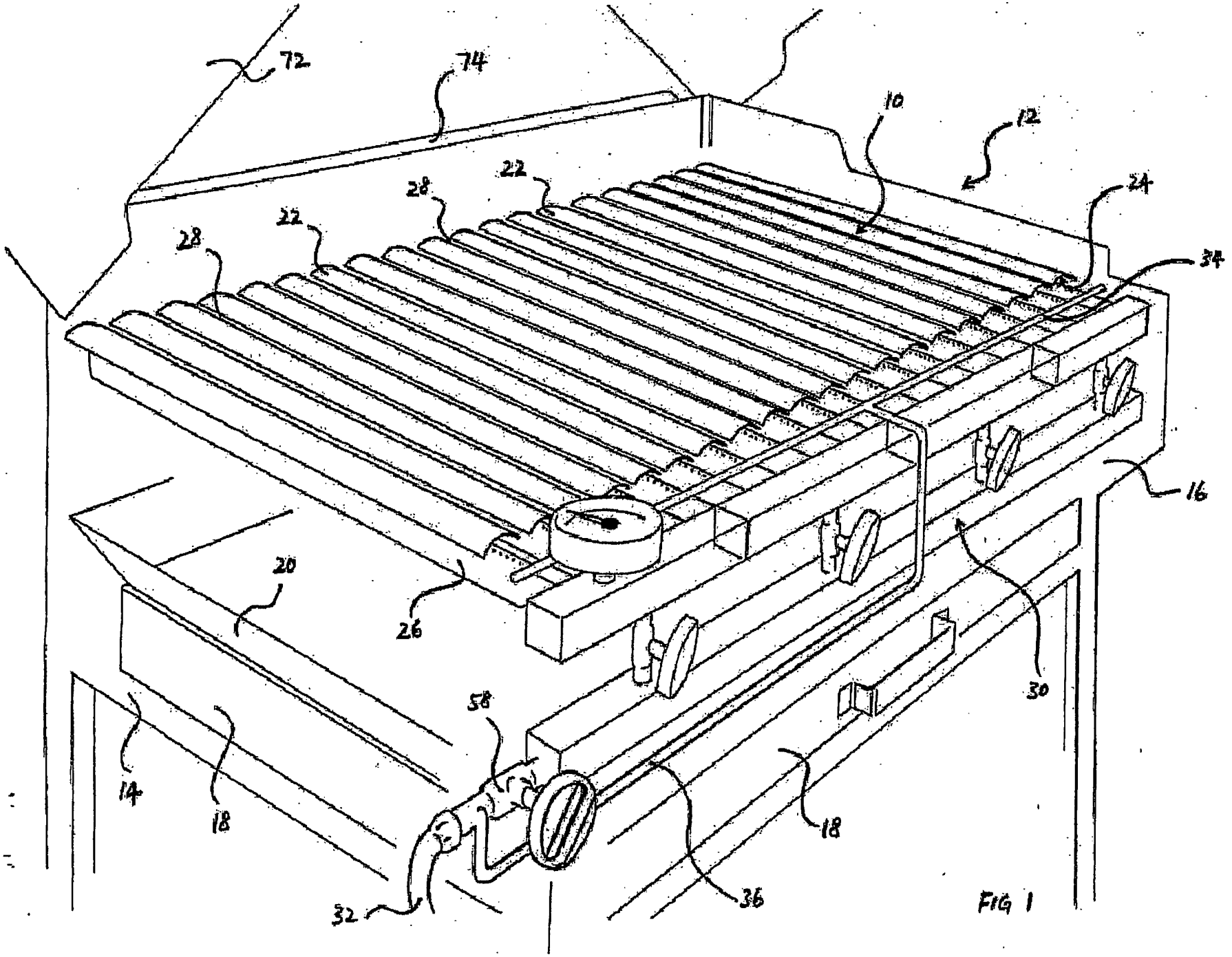
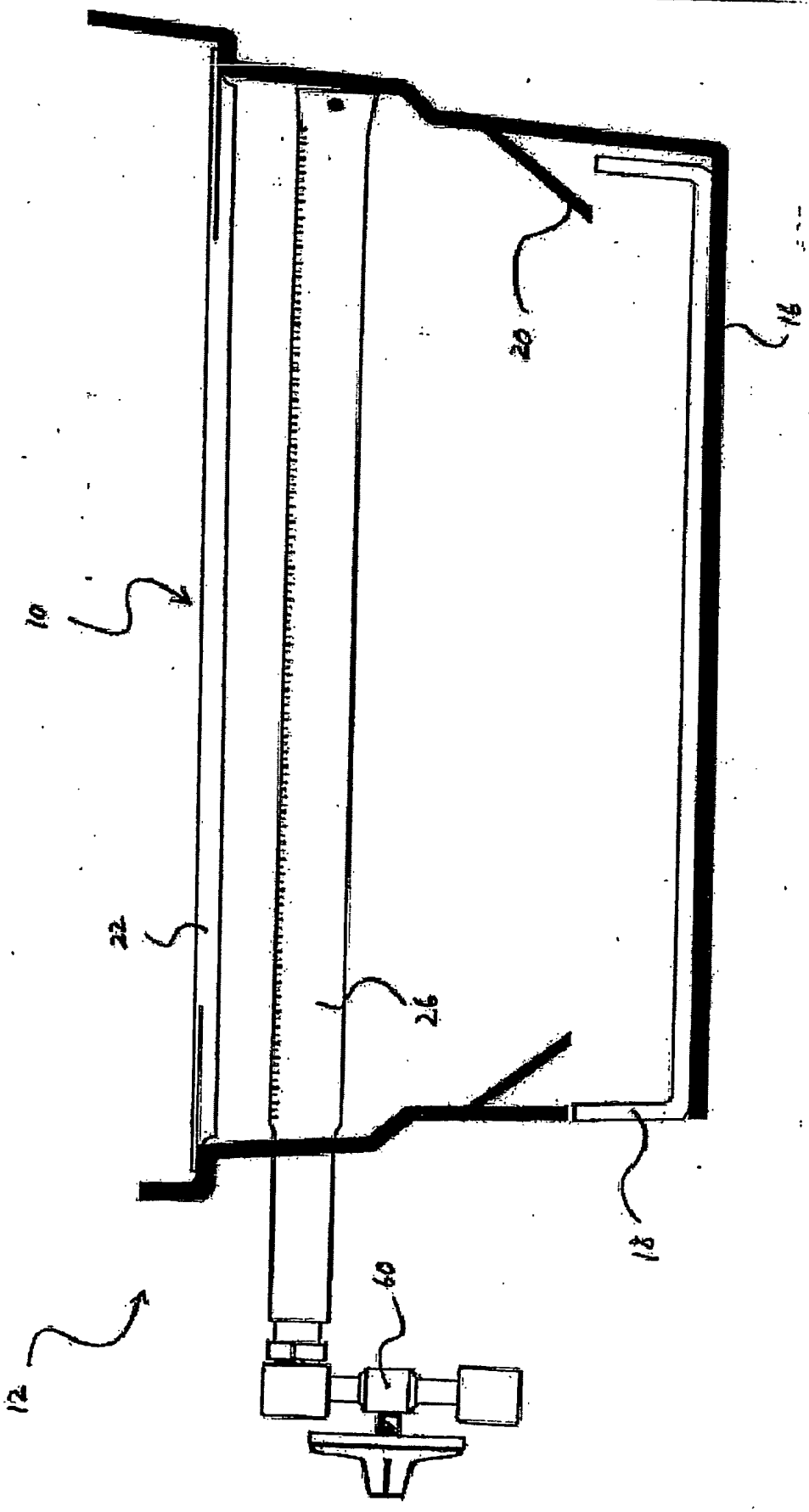


FIG 1

FIG 2



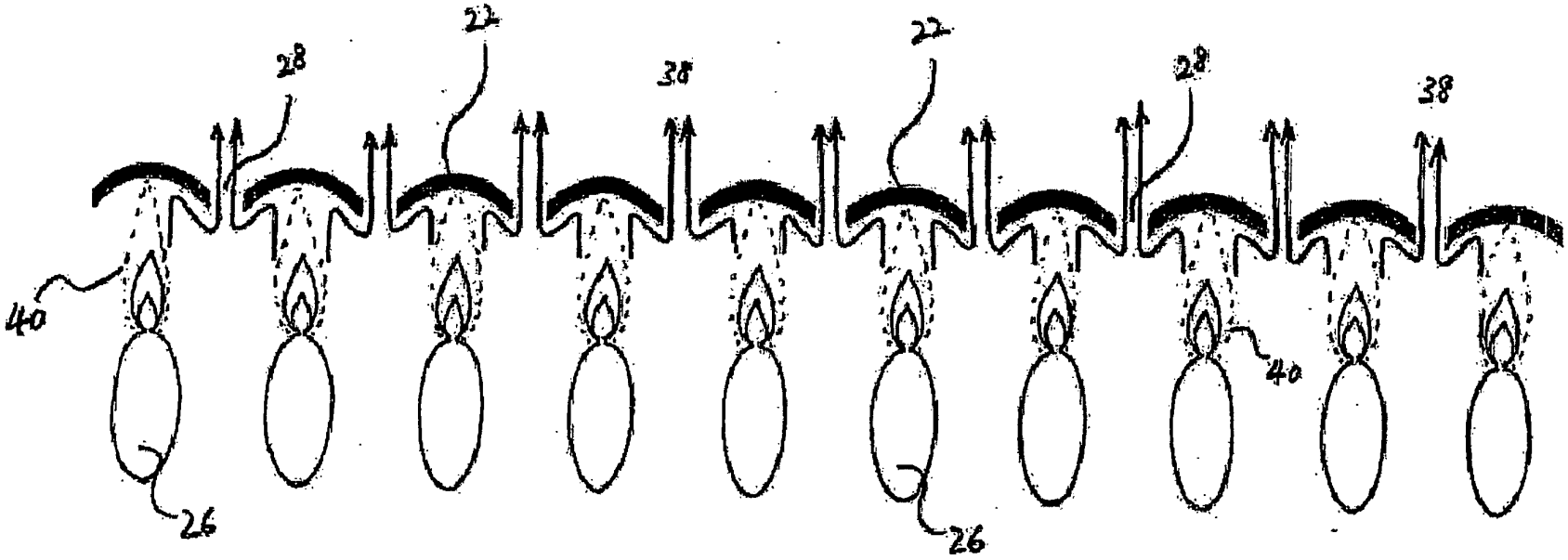


FIG 3

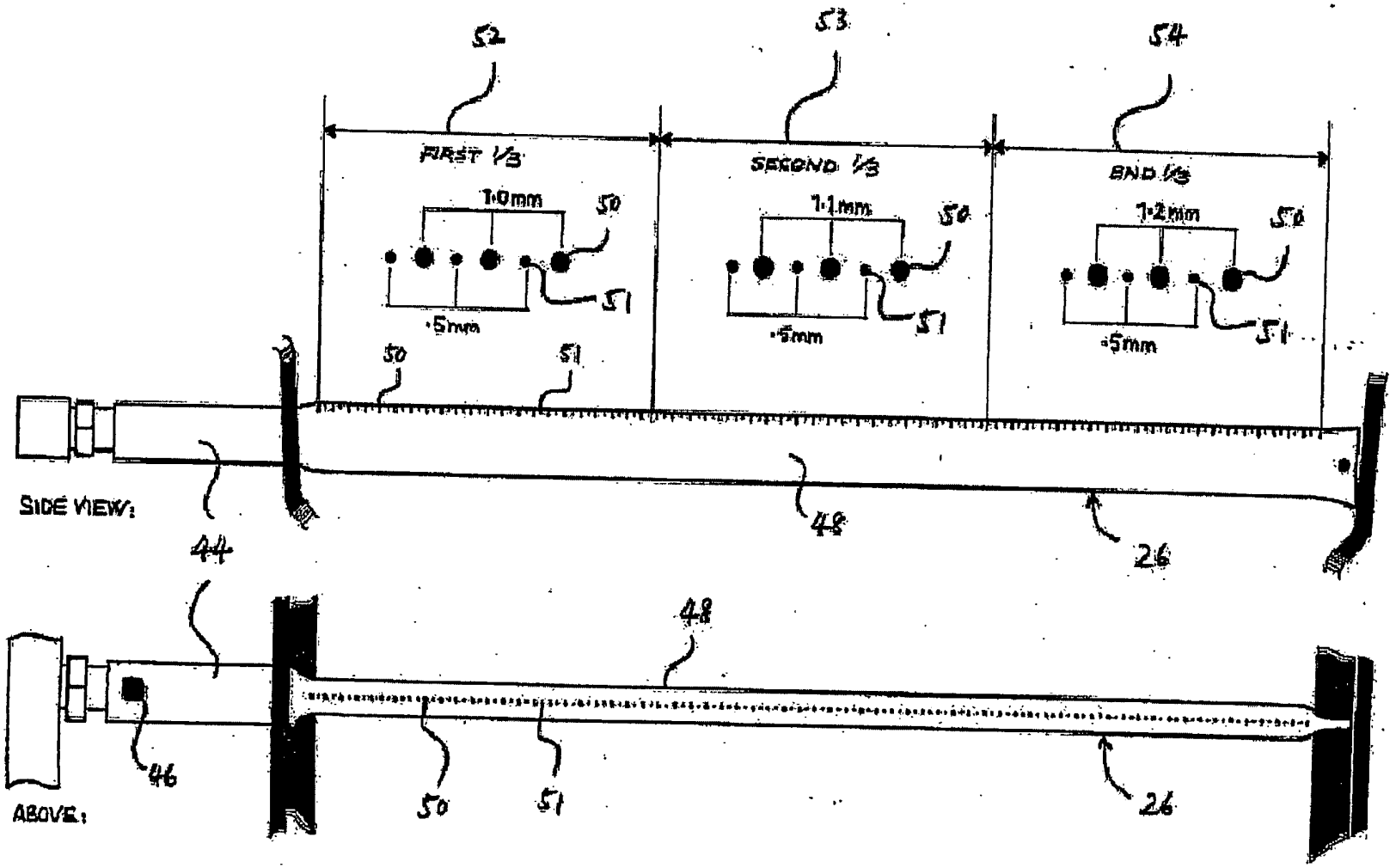

52
53
54
FIRST 1/3
SECOND 1/3
END 1/3
1·0mm
1·1mm
1·2mm
50
51
·5mm
SIDE VIEW:
44
48
26
ABOVE:
46

FIG 4

FIG 5

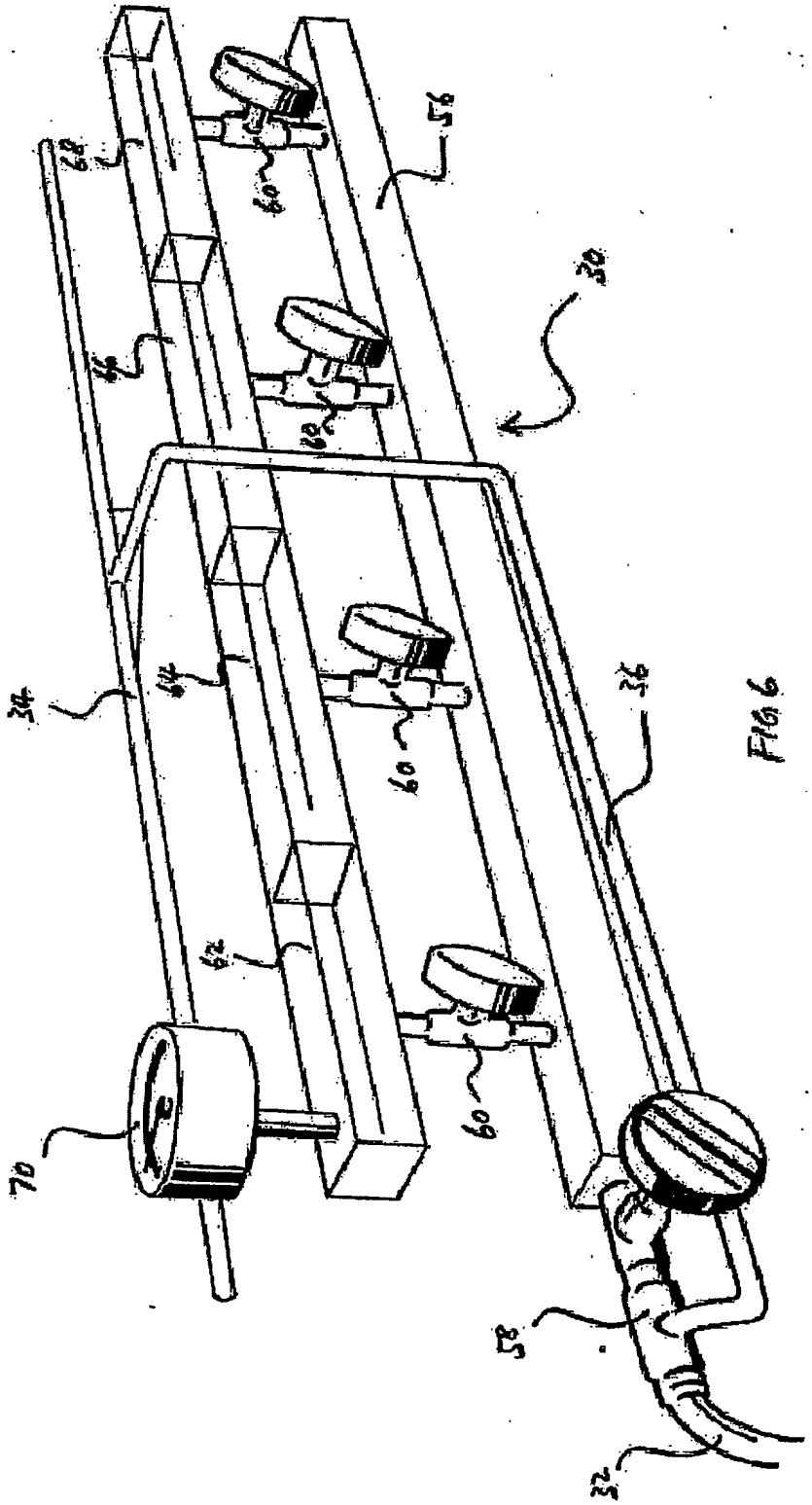


FIG 6

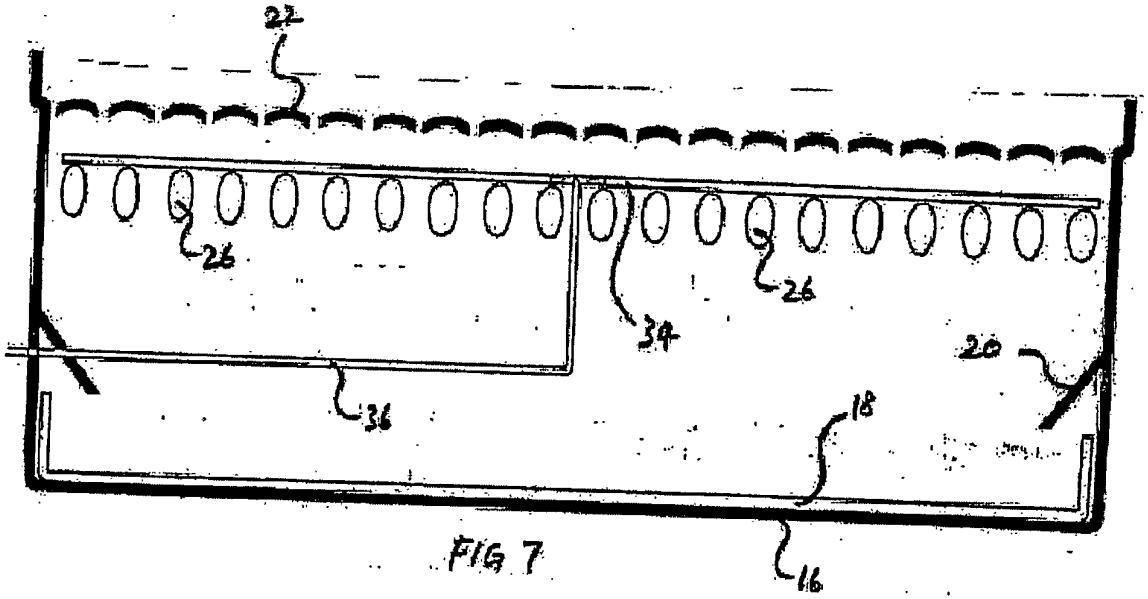


FIG 7

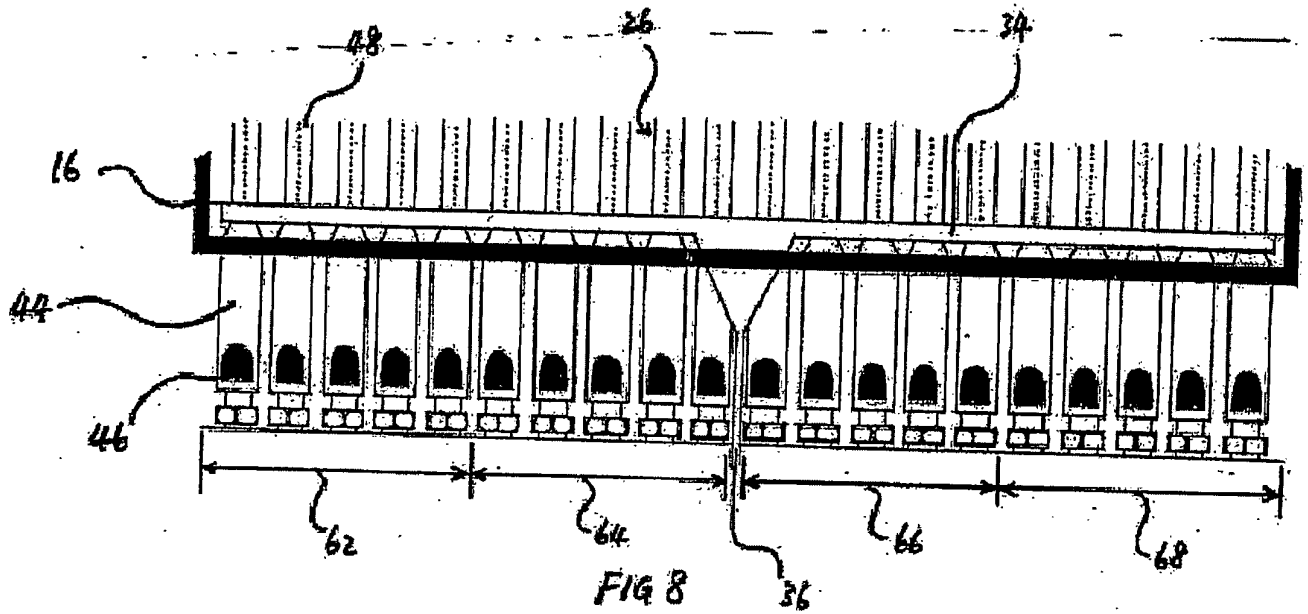


FIG 8

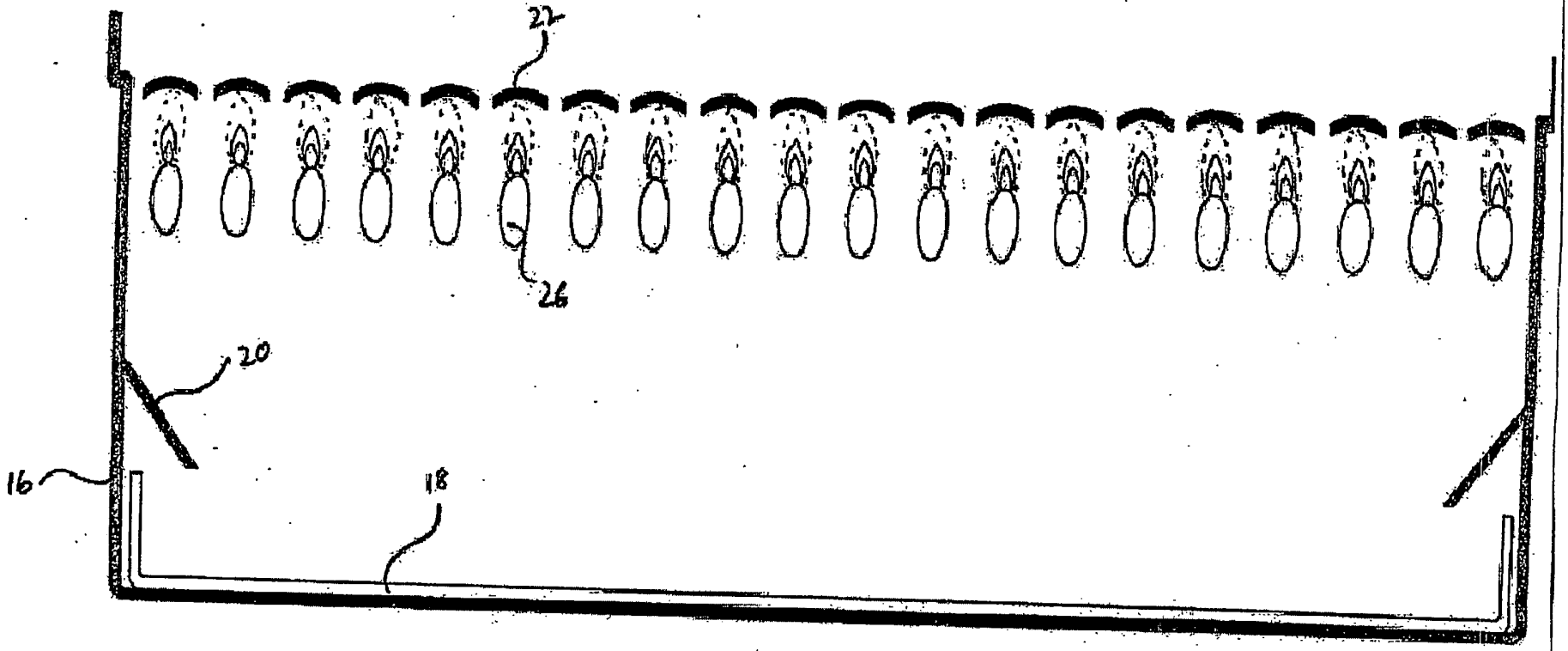


FIG 9

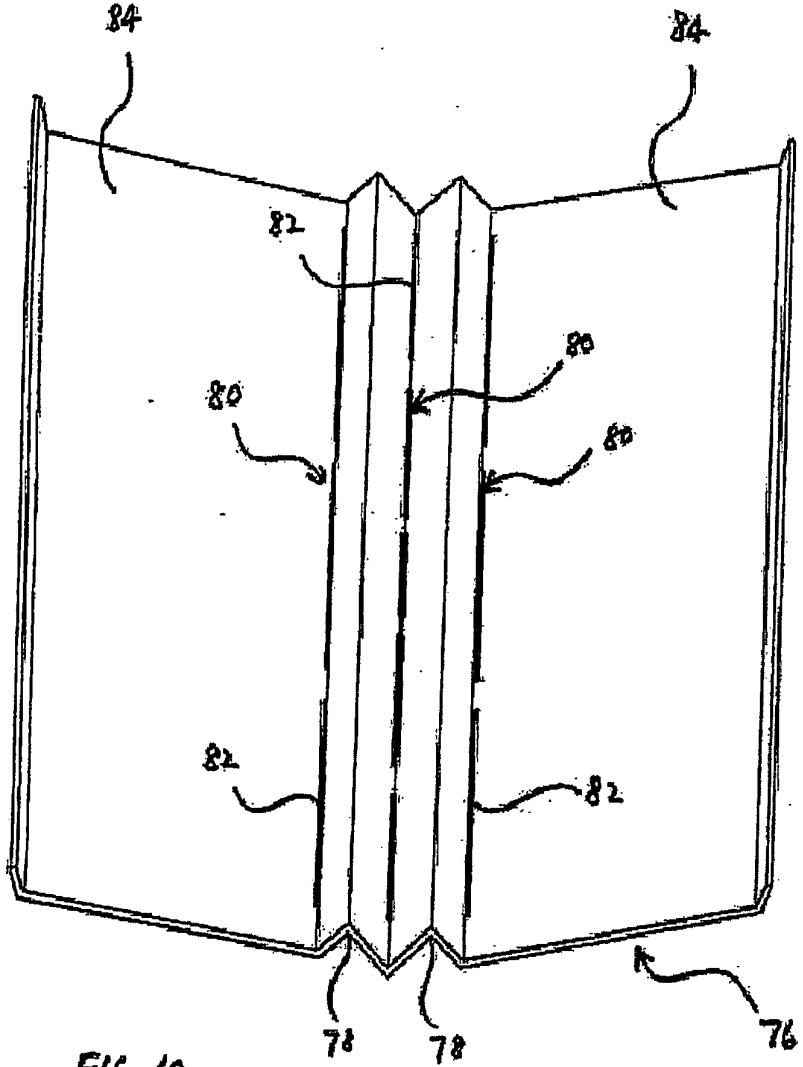


FIG 10

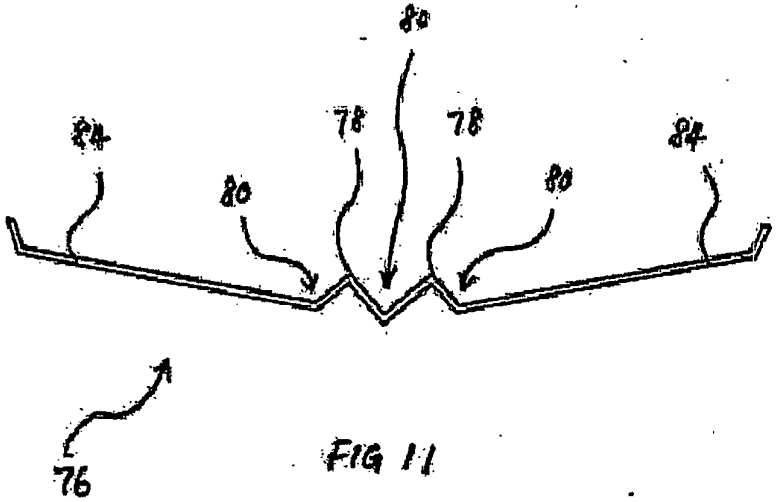


FIG 11

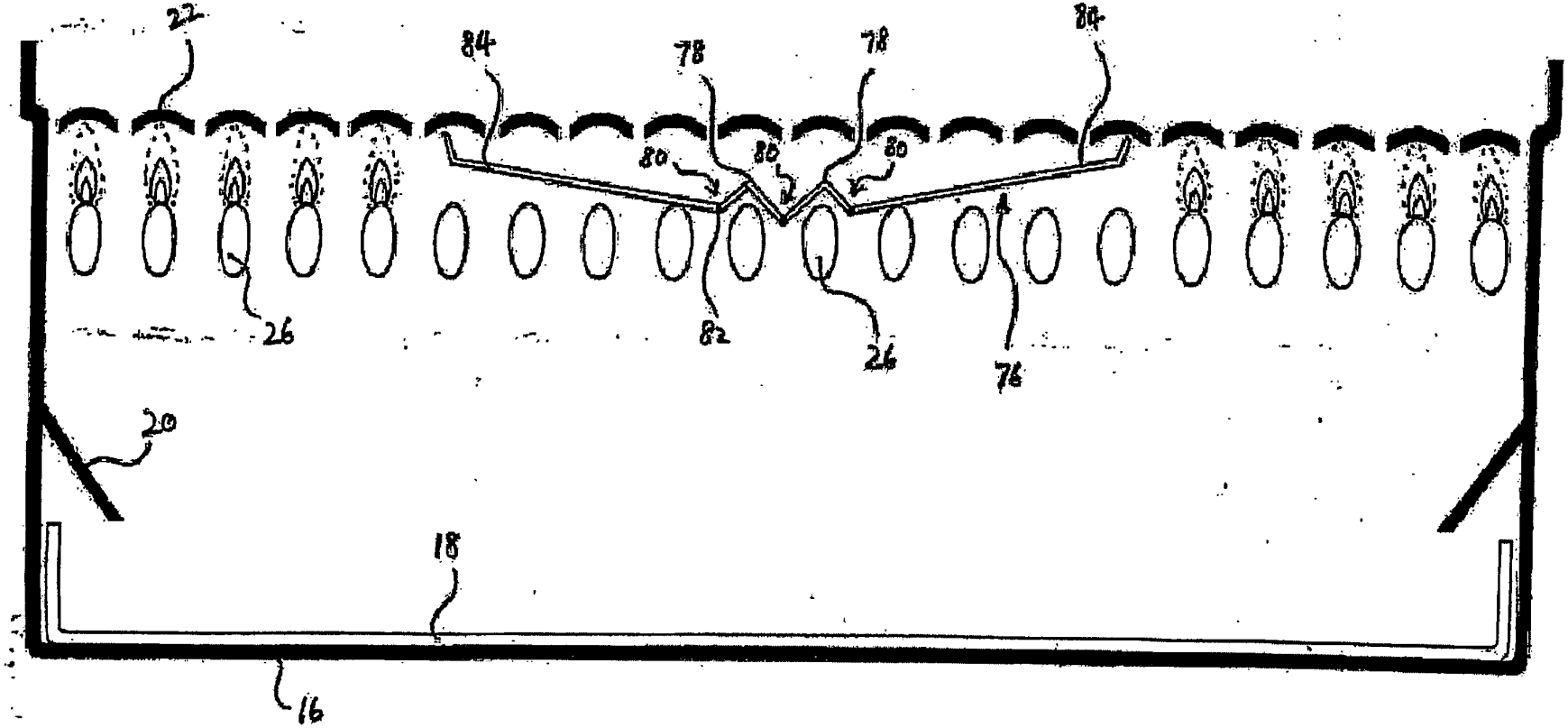
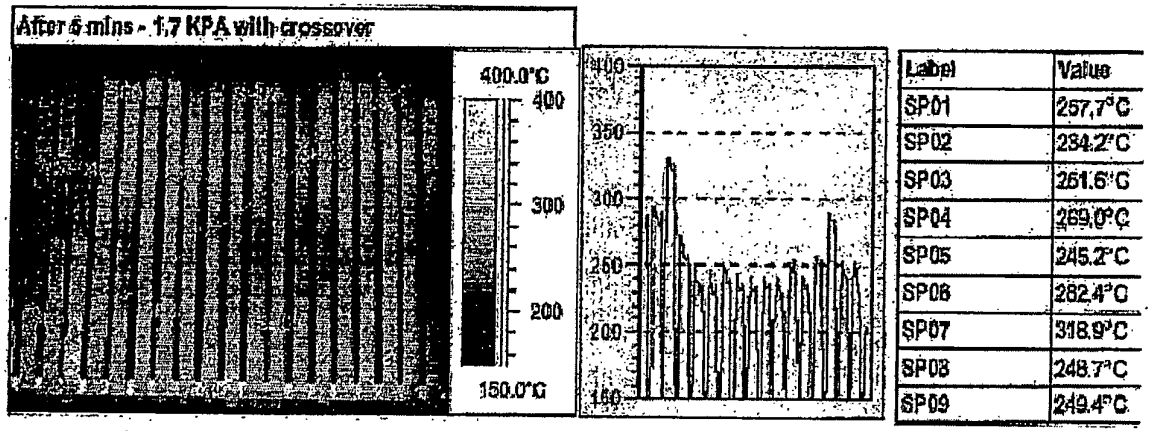
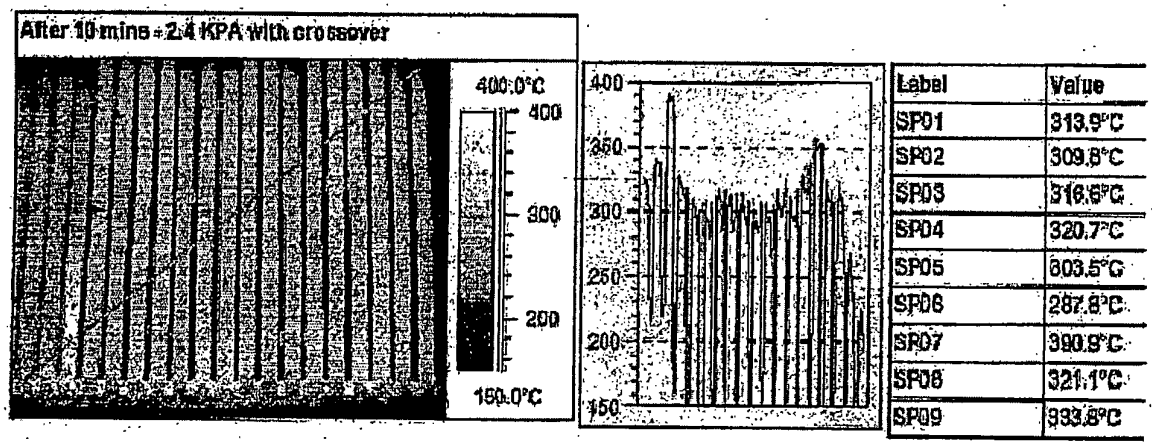


FIG 12



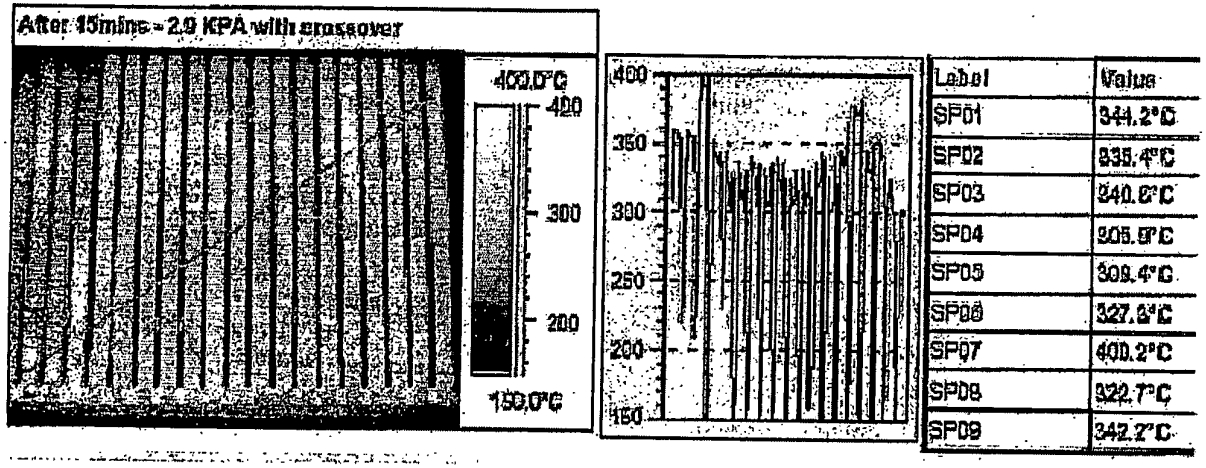
Label	Value
SP01	257.7°C
SP02	234.2°C
SP03	261.6°C
SP04	269.0°C
SP05	245.2°C
SP06	282.4°C
SP07	318.9°C
SP08	248.7°C
SP09	249.4°C

Figure 13



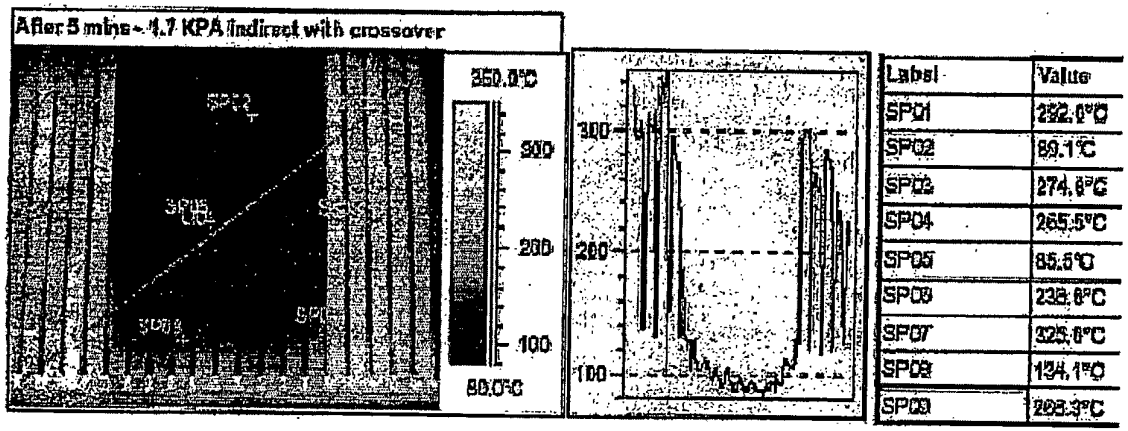
Label	Value
SP01	313.9°C
SP02	309.8°C
SP03	316.6°C
SP04	320.7°C
SP05	303.5°C
SP06	287.8°C
SP07	390.9°C
SP08	321.1°C
SP09	333.8°C

Figure 14



Label	Value
SP01	344.2°C
SP02	335.4°C
SP03	340.6°C
SP04	305.9°C
SP05	309.4°C
SP06	327.5°C
SP07	400.2°C
SP08	322.7°C
SP09	342.2°C

Figure 15



Label	Value
SP01	252.0°C
SP02	89.1°C
SP03	274.8°C
SP04	265.5°C
SP05	85.5°C
SP06	238.6°C
SP07	325.6°C
SP08	134.1°C
SP09	266.3°C

Figure 16

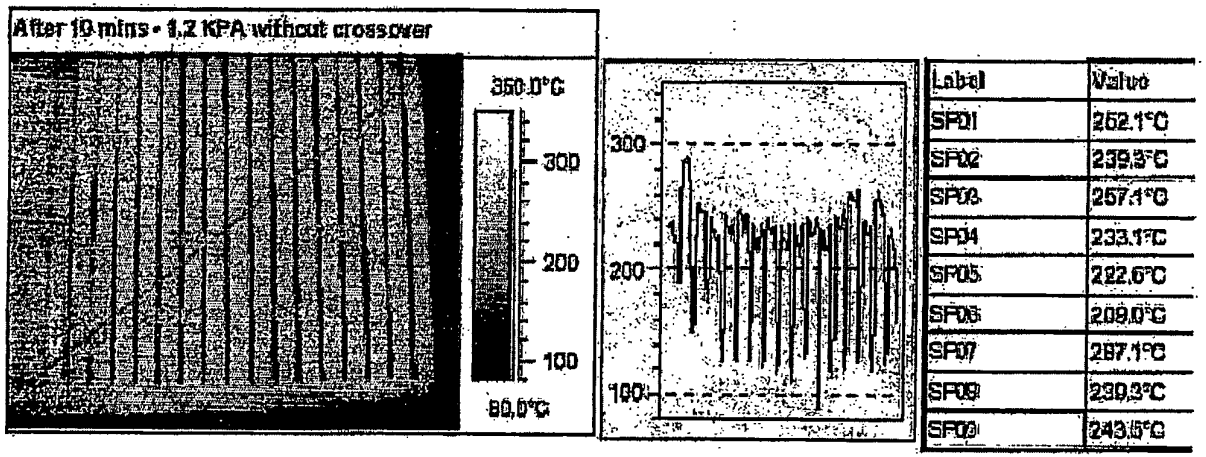


Figure 17

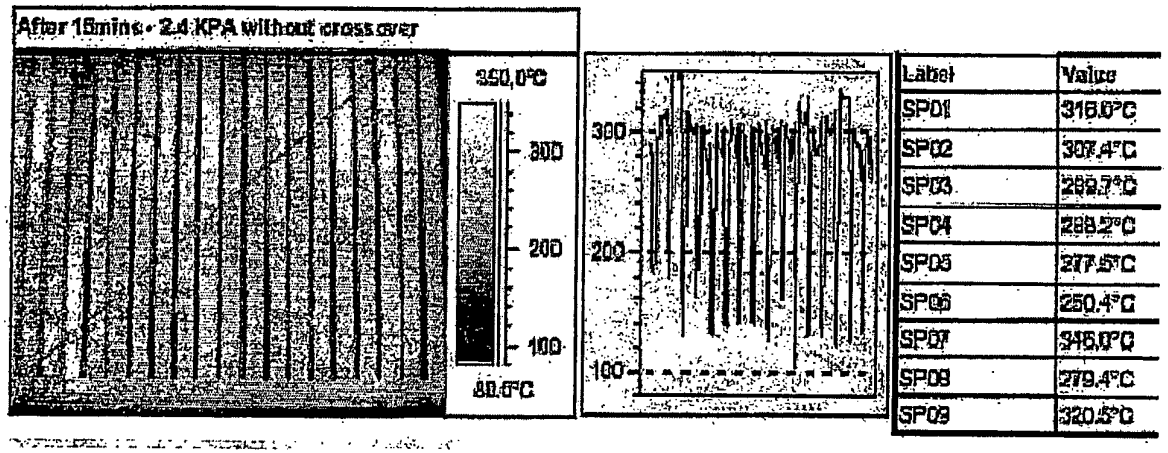
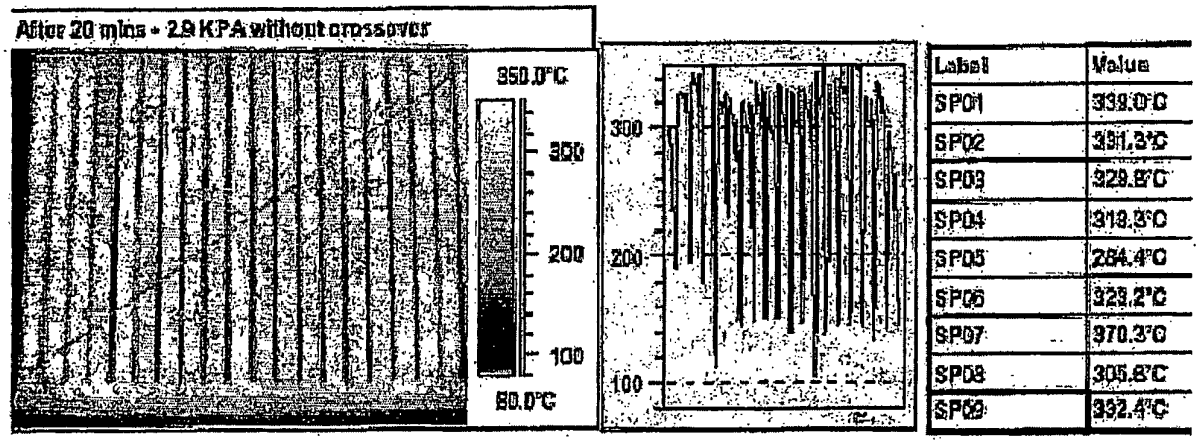
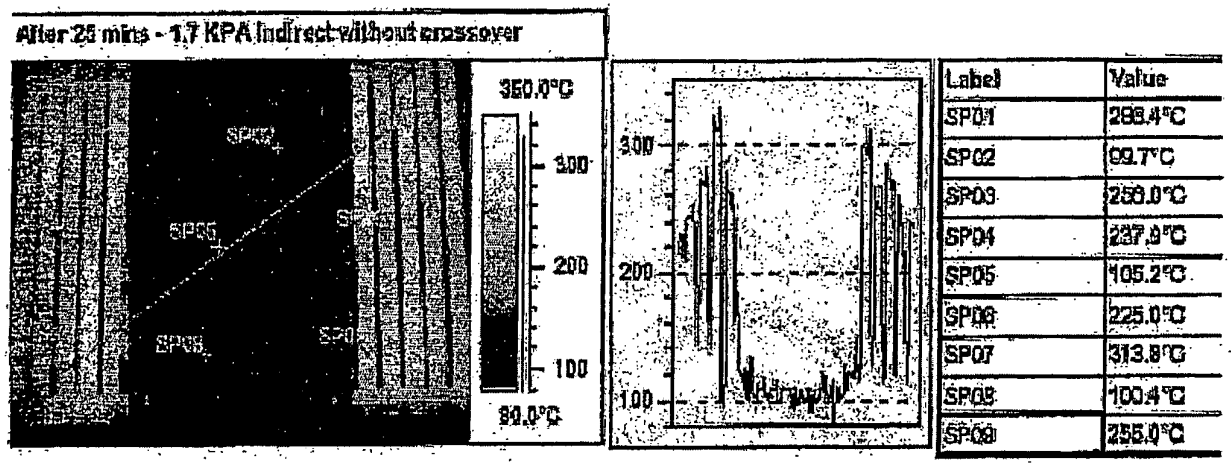


Figure 18



Label	Value
SP01	339.0°C
SP02	331.3°C
SP03	329.8°C
SP04	318.3°C
SP05	284.4°C
SP06	323.2°C
SP07	370.3°C
SP08	305.8°C
SP09	332.4°C

Figure 19



Label	Value
SP01	288.4°C
SP02	09.7°C
SP03	256.0°C
SP04	237.9°C
SP05	105.2°C
SP06	225.0°C
SP07	313.8°C
SP08	100.4°C
SP09	255.0°C

Figure 20

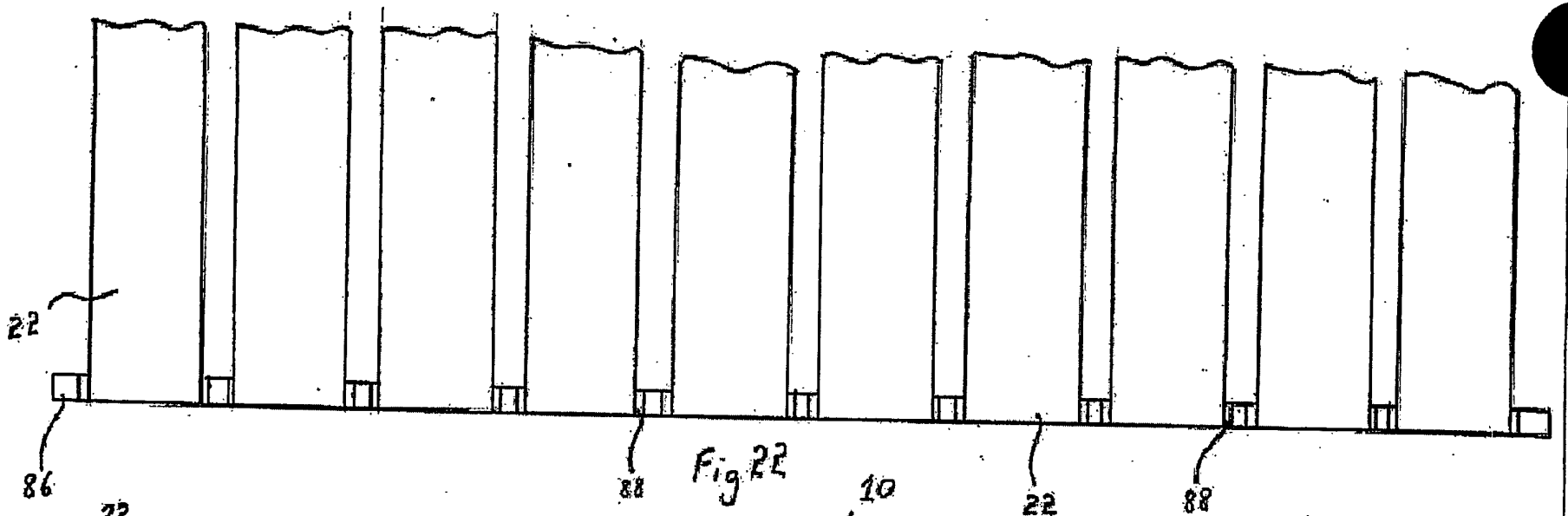


Fig 22

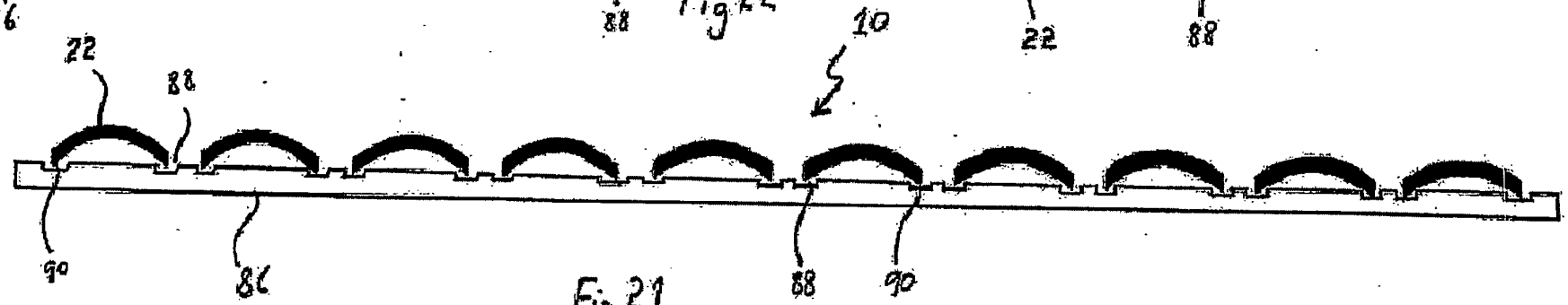


Fig 21